Monetary Aggregates: Their Use in the Conduct of Monetary Policy

Updated March 16, 2009

Congressional Research Service
https://crsreports.congress.gov
RL31416

Summary

Economic theory and history make a compelling case that monetary policy is powerful in affecting the pace of economic activity and employment in the short run and the rate of inflation in the longer run. Thus, unambiguous indicators should exist for those formulating, executing, and overseeing monetary policy. To this end, definitions of money are sought, as are collections of assets consistent with those definitions. For these measures of money—known as monetary aggregates—to be useful in a policy context, they must, at a minimum, be stable and predictably related to spending, meaning that when they are changed, the subsequent change in spending can be closely predicted. If they meet that test they can provide *information* about the current stance of monetary policy. Should they be under the control of the Federal Reserve (Fed), they may be useful as *intermediate target variables* in the execution of monetary policy.

The monetary aggregates constructed by the Fed are no longer stable and predictably related to spending, although they once may have been. A vast number of studies have sought to explain the reason for this sudden instability. Their findings highlighted efforts by financial institutions to get around federal regulations, structural changes related to economic development, the use of U.S. currency abroad, and a number of one-time events such as the thrift crisis of the mid-1980s. Accounting for these developments led to refinements of the existing aggregates, development of new aggregates, and new measures of opportunity costs. At most, this research suggests that the refined old and new aggregates can provide useful information about future income growth, employment, and inflation. Several of the aggregates, however, do not seem to be under the control of the Fed.

Were monetary aggregates to exist that were stable and predictably related to spending and under the control of the Fed, their use in the conduct of monetary policy would likely be controversial. Some economists, who see monetary instability as the major cause of business cycles, favor a *rule*-based policy of increasing the aggregates at a fixed percentage per year. Others, with different notions of the causes of cyclical instability, tend to favor a *discretionary* approach to policy and monetary fine tuning.

If ideal monetary aggregates do not exist or are not under the control of the Fed if they do exist, monetary policy can be formulated and executed in terms of interest rates. However, the relevant interest rates for household and business spending decisions are the real or inflation-adjusted rates. These rates can be affected by actions of others in the economy in addition to the Fed and by developments abroad. Thus, their movements may provide little information about monetary policy.

The oversight of monetary policy is handicapped by a lack of reliable, objective, and unambiguous monetary indicators. This leads to the unhealthy situation in which those responsible for overseeing monetary policy must rely heavily on the Fed to provide them with an assessment of policy, which may hinder an arms length assessment. This report will be updated.

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Introduction

The Federal Reserve (Fed) conducts monetary policy by buying and selling U.S. Treasury securities. This action alters the reserves of financial institutions, primarily commercial banks, which in turn alters the availability of money and credit in the U.S. The ultimate goal of Fed activity is to influence aggregate spending to achieve a low and stable inflation rate and maximum sustainable economic growth and employment over time.[1]

In conducting monetary policy, the Fed has a choice of a target. Since money spending involves money, it could buy and sell U.S. Treasury securities with the objective of targeting the growth of the money supply. Alternatively, since changes in money and credit affect spending largely through changes in interest rates, it could target one or more of those rates directly simply by supplying whatever reserves are needed to meet its target. It cannot target money growth and interest rates simultaneously, however.

The discussion in this report concentrates primarily on targeting the money supply to achieve such changes in money spending that the goals of full employment and stable prices are met. In recent years, the Fed has targeted interest rates instead of the money supply. An important reason for this choice, as discussed below, is the unstable link between the money supply and money spending. Nevertheless, some economists for several reasons continue to prefer targeting money growth, and seek a stable measure of money as a means of furthering that goal.

The Link Between the Monetary Aggregates and the Economy

There are few topics in economics as contentious as the role of money in business cycles. No doubt that money and economic activity are highly correlated. **Table 1** sets out the nature of this relationship. The average rate of growth of nominal gross domestic product (GDP) over the past four decades is shown relative to the average growth of a popular measure of money known as M2, which is defined in the glossary.

One cannot help but be struck by the close relationship between the two variables over most of the period. Moreover, when the growth rate of real GDP is subtracted from that of nominal GDP, the growth rate of M2 provides a good deal of information about the rate of inflation. For example, over the period 1960-2008, M2 grew at an average compound annual rate of 7.0% whereas real GDP grew at an average compound annual rate of 3.3%. The difference, 3.7%, is exactly equal to the average annual compound rate of growth of the implicit price deflator for GDP, 3.7%.[2] Thus, the excess of M2 growth over real GDP growth seems to be highly correlated with the inflation rate over this nearly half century period.

Table 1. Growth Rates of Gross Domestic Product and M2

Time Period	Average Growth Rate of Nominal GDP	Average Growth Rate of M2
1960-1969	7.2%	7.3%

[1] For an overview of monetary policy, see CRS Report RL30354, *Monetary Policy and the Federal Reserve: Current Policy and Conditions*, by Marc Labonte and Gail Makinen.

[2] Generally, 1960 is chosen as a base date for making comparisons because the money supply data for earlier years are not quite compatible with the post-1959 data.

Time Period	Average Growth Rate of Nominal GDP	Average Growth Rate of M2
1970-1979	11.2%	9.9%
1980-1989	8.8%	8.0%
1990-1999	6.0%	3.8%
2000-2008	4.8%	6.3%

Source: Board of Governors of the Federal Reserve; Bureau of Economic Analysis.

It is well known that correlation measures only the degree to which variations in the two data series coincide. It does not necessarily imply anything about cause and effect. Indeed, in terms of **Table 1**, the contention among economists is whether the changes in M2 cause the changes in nominal GDP or vice versa. The jury is still out on this question and probably will never be able to render a verdict acceptable to all parties. Nevertheless, the relationship of money to economic activity suggests two possible roles that money might play in the formulation and execution of monetary policy.

The first role is that of an *intermediate target variable.* In this role, the Fed would manipulate the money supply or its growth rate to achieve such goals as high employment, high real GDP growth, or low inflation. As far as inflation is concerned, the information above suggests that a growth rate of M2 of about 3.5% per year would yield a fairly stable price level (or low rate of inflation).

For M2,or any other measure of money to be used as an intermediate target, it must be either directly or indirectly under the control of the Fed. For much of the Federal Reserve era (after 1913), control of the money supply was not a viable option. This was because the United States adhered to an international monetary system that used fixed exchange rates. A central feature of fixed exchange rate regimes is that monetary policy must be directed to maintaining the exchange rate. As such, it cannot focus on manipulating the money supply in a way that is inconsistent with that objective.

Since the early 1970s, however, the United States has participated in the international monetary system on the basis of flexible exchange rates. Under this system, central banks theoretically have great freedom in manipulating their respective national money supplies. However, they do not have *direct* control over that supply. Rather, they control the reserves that are available to depository institutions, on the basis of which deposit money can be created.[3] How much money is created in any given period also depends on other factors. Important among these are the preferences of the public for how it wishes to hold its money assets (in the case of M2 this means currency, demand deposits, and various types of saving and time deposits) and the actions of depository institutions that influence those preferences. Also of some importance are the reserves that depository institutions choose to hold relative to the various types of deposit liabilities outstanding (some of these are legally imposed while others are voluntary). A more extensive discussion on the ability of the Fed to control the money supply is given below.

[3] Control over reserves is supplemented by control over the legal reserve obligations imposed on these institutions (the obligations were differentiated by the type of deposits supplied by these institutions) and by control over the discount rate which sets the cost to a depository institution when it must borrow reserves from the central bank to make up any reserve deficiencies. Additional complications were introduced in the summer of 2008 when the Federal Reserve began to pay interest to banks on their reserve holdings. Hitherto, reserves produced no income for banks as they held to be held either as vault cash or as a deposit at the Federal Reserve.

Thus, the Fed does not have day-to-day control over the money supply. Its control is only indirect and depends on the closeness of the relationship of reserves to the various measures of money.

Even though a case can be made that the Fed has been able to use the money supply as an intermediate target variable for the past 30 years or more, it has apparently chosen not to do so.[4] In recent years, this reluctance has been associated with what has been called the "instability in the velocity or turnover rate of money." While this topic is discussed below, what is involved can be gleaned from **Table 1**. The close relationship between money and nominal GDP, so evident in the 1960-1989 period, is weaker in the 1990-1999 period. Clearly something altered the relationship between M2 money growth and the growth in nominal GDP.

Nevertheless, for a considerable period of time the Federal Reserve reported to Congress growth rate target ranges for various measures of money. This practice commenced in the early 1970s and ended in the 1980s and 1990s (depending on the measure of money). This practice may seem curious since manipulating these measures of money is not the objective of monetary policy. One might even have questioned the usefulness of this exercise. However, the data above do show that for much of the past 50 years money growth (measured as M2) has been closely related to both nominal GDP growth and the rate of inflation.

Even if causation runs from income growth to money growth, or if the Federal Reserve cannot control the money supply, or it chooses not to control the money supply, movements in the growth rate of the money supply might, nevertheless, provide a good deal of useful information about some important performance parameters of the economy. For example, the data above suggest that the growth rate of M2 has been a good predictor of (or source of information about) the future growth of nominal GDP and the rate of inflation.

However, for money to be the preeminent *informational variable*, the close relationship between it and various measures of economic performance must continue. Although the conditions under which a measure of money serves as an informational variable are less demanding than in its role as an intermediate target variable (e.g., it does not have to be under the control of the Fed) its usefulness in providing information diminishes in the absence of a close relationship between it and, for example, aggregate spending. Thus, the emergence of "velocity instability" which reduced the usefulness of money as an intermediate target variable has also reduced its usefulness as a source of information about the current and expected performance of the economy.

The Velocity of Money

Although the amount of money in existence is an important determinant of the amount of money spending that can or will take place, it is not the only factor. Also of importance is the number of times each unit of money is spent during a given time period. This spending or *turnover rate* of the existing amount of money is commonly known as the *velocity of money* or *the velocity of money's circulation*.

These notions can be formalized in terms of a simple equation. Let the amount of money in existence be symbolized by **M**, its velocity of circulation by **V**, and total money spending by **PY** (where **P** is a price index and **Y** a measure of the quantity of real goods and services). Then:

$$\mathbf{MV = PY}$$

In order to calculate V (which is equal to PY/M), we need to be able to measure both M and PY.

[4] During the period October 1979 to October 1982, the Federal Reserve appeared to use the growth of M1 as an intermediate target. This episode is examined below.

In theory, PY symbolizes total money spending on all goods, services, and financial and real assets that takes place in an economy over a given time period. Since measures of total spending do not exist, PY is often proxied by the nominal value of GDP or some subdivision thereof such as net national product, national income, personal income, etc. Given any measure of PY, the calculated value of V will be different for different definitions of M (and, for each definition of M, V will also differ for different measure of PY).

The Definition of Money

Providing a generally accepted definition of money has proven to be elusive. Economists have taken several approaches to this task. The first has been what might be called the traditional or functional approach. It starts by saying that "money is what money does." And money is any asset that simultaneously performs all four of the basic functions of money: serving as a unit of account, medium of exchange, store of value, and standard of deferred payment. A second definition holds that money is a "temporary abode of purchasing power." This definition seems to focus on the store of value role stressed by the traditional definition. The role of each definition in selecting a group of assets to call money is worth exploring for it rationalizes the composition of assets included in M1 and M2.

The unit of account role is basic to money as it is the common denominator in terms of which all goods, services, and assets can be expressed and their relative values compared. In the case of the United States, the unit of account is the dollar.[5] The medium of exchange role says that whatever is money must be the dominant means used to make payments or effect exchange. The store of value role emphasizes that money is a generalized means for holding wealth. The standard of deferred payments means that money is used for writing contracts that require future payments.

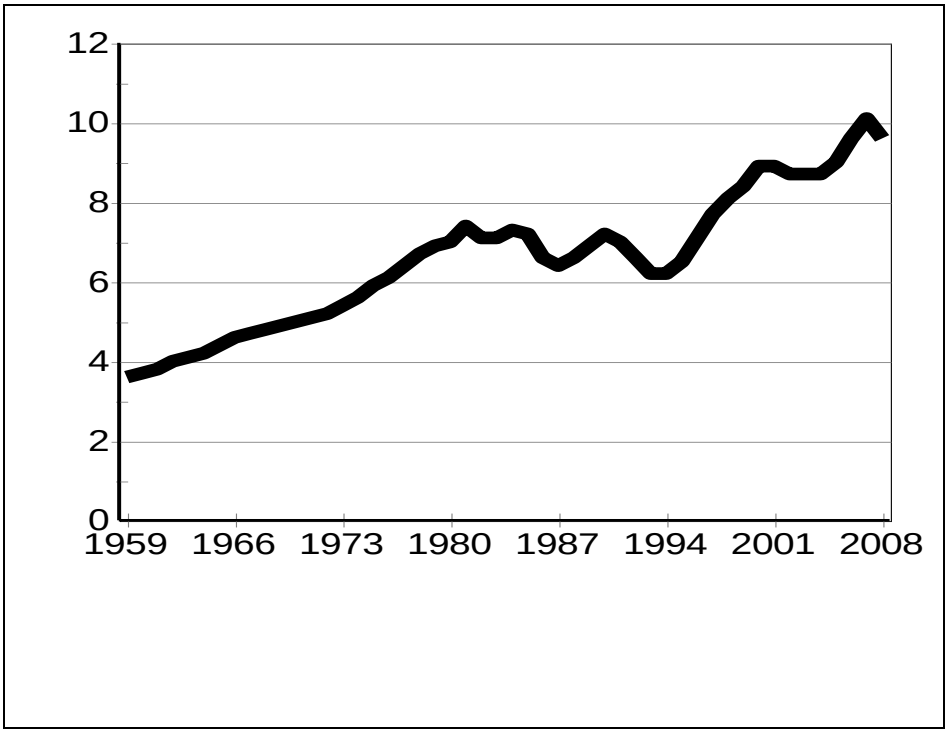
The Functional Definition of Money (M1)

The functional definition suggests that money consists primarily of those assets that can be used to make transactions—mainly paper currency (including coins) and deposits against which checks can be drawn. This collection of assets corresponds closely to what the Federal Reserve has defined, since 1980, as M1.

The M1 velocity of money is shown in **Figure 1**. It is calculated by letting the nominal value of GDP serve as a proxy for total money spending or PY. It is obvious from **Figure 1** that the M1 velocity of money has not been a constant. Throughout much of the post-1959 period, it rose. Between 1959 and 1981, M1 velocity grew at a compound average rate of about 3.3%. It declined from 1981 to 1994 and then began to rise. By 1997, it had surpassed its 1981 peak, and by 2007, it reached its highest value in the 1959-2008 period. Between 1997 and 2008, M1 velocity grew at an average compound rate of 2.0%, considerably below its average growth rate from 1959 to 1981.

[5] The dollar was originally defined as a given quantity of gold. Over time it has evolved into an abstract measure. The unit of account role is common to all definitions of money since we measure money using the dollar.

Figure 1. Velocity of M1



Source: Federal Reserve

For M1 to be used as an intermediate target variable, as noted above, it must be under the control of the Federal Reserve. Fed control in this case is indirect because the composition of M1 is determined by the preferences of the public. Fed control resides primarily in control over the reserves available to depository institutions, and the evidence suggests that reserve growth is the major determinant of the growth of M1.

Control, however, is not in itself sufficient for using M1 as an intermediate target variable. Its velocity must be *stable* and *predictable*. This means that the behavior of M1's velocity must depend on and be explained by, ideally, a few variables. Knowledge about the value of these variables will allow monetary authorities to predict the value of V. If the behavior of V depends on a large number of variables, it would be regarded as less predictable even if it were stable. If velocity is not stable and predictable, then control of M1 will not ensure control of money spending. Moreover, its ability to function as an informational variable or its usefulness as an indicator of the future performance of the economy will also be compromised as the growth rate of M1 (or any M) may provide little information about the subsequent growth of spending and the rate of inflation.

Does the behavior of M1 velocity shown on **Figure 1** suggest that it is unstable? After all, it rose continuously for more than 20 years and then, for the next 13 years, it followed a pattern that moved downward in an erratic sort of way, to be followed by fourteen years of upward growth at an average rate that was considerably less than over the 1959-1981 period.

This behavior need not indicate instability. To see why, the factor or factors thought to determine how rapidly the public spends or turns over its money must be explained. Economists have devoted considerable efforts to this task. A widely used behavioral model was developed by

Professors Baumol and Tobin.[6] In their model, money is held only to make transactions. How much is held comes to depend not only on planned transactions, but on two other factors: the income lost by holding money rather than some interest earning asset (the so-called opportunity cost of money) and the brokerage fee or cost, both financial and physical (e.g., time and inconvenience) incurred when the income earning assets are converted into money.[7]

In this model, as interest rates rise, individuals will hold less money relative to transactions (velocity will rise). Similarly, any innovation that lowers the transactions cost of converting income-yielding assets into money will also decrease money holdings relative to transactions (velocity will rise).

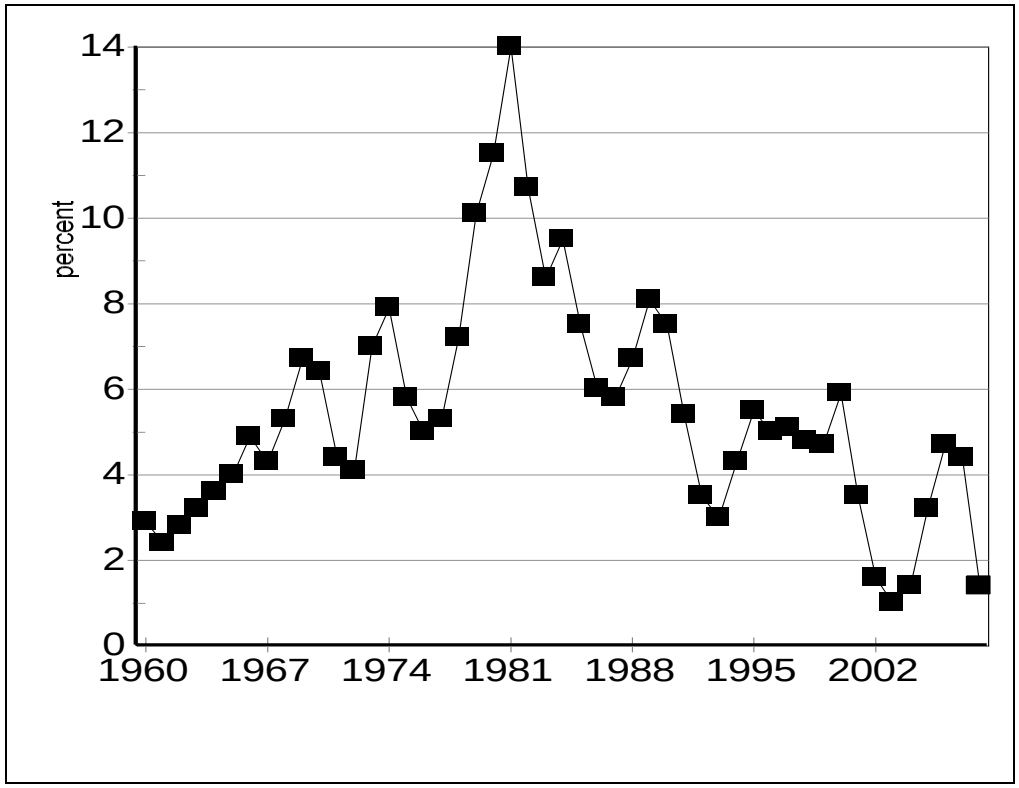
As this model was originally estimated, economists believed that the income-yielding asset most likely to be held in lieu of money was one that was short term and highly liquid such as a (3-month) Treasury bill. If this is a correct choice, can the yield on 3-month U.S. Treasury bills explain the behavior of M1's velocity? The annual yield on these bills during the period 1958-2008 is recorded on **Figure 2**. The most noticeable feature of these data is that they trend upward reaching a peak in 1981 and, then record a general decline over the subsequent 27 years.

Had M1 velocity mirrored these movements a case could be made for stability. Unfortunately, this is not possible. Between 1959 and 1981, M1 velocity moved upward as interest rates rose. Between 1981 and 1995, M1 velocity declined as did interest rates. However, as interest rates continued their general decline from 1995 through 2008, M1 velocity began to rise indicating instability in the fundamental relationship. Something else hitherto unaccounted for was exerting an important influence on M1 velocity.

[6] William J. Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," *Quarterly Journal of Economics*, vol. 66, November 1952, pp. 545-556; and James Tobin, "The Interest-Elasticity of Transactions Demand for Cash," *Review of Economics and Statistics*, vol. 38, August 1956, pp. 241-247. Note that the Baumol-Tobin model explains money holding or money demand rather than velocity. This is a distinction without a difference. If households and businesses are holding money balances equal to one-fifth of income or total spending, then the velocity of money must be 5 and any factor that reduces desired money holdings must raise the velocity of money and vice versa.

[7] The seminal discussion of the determinants of velocity is Irving Fisher, *The Purchasing Power of Money* (New York: MacMillan, 1911). In addition to foregone income, Fisher also listed as determinants such factors as the frequency of payments, size of payments, certainty of payments, the coordination of income and payments, the distribution of income among classes, the state of confidence, the availability of credit, uncertainty about the future, etc. These other factors are thought to have a longer run influence on the behavior of velocity. For a discussion of the development of velocity in the history of economic thought, see Thomas M. Humphrey, "The Origins of Velocity Functions," Federal Reserve Bank of Richmond *Economic Quarterly*, vol. 79, Fall 1993, pp. 1-17.

Figure 2. The Yield on 3-Month U.S. Treasury Bills



Source: Federal Reserve

Velocity Instability and the "Missing Money"

Much of the discussion about the instability (or lack of predictability) of M1's velocity, to be reviewed below, has been carried out in terms of the "missing money" rather than address instability directly. This occurs because rather than talk about the velocity of M1 directly, various authors have phrased their investigations in terms such as "given the level of GDP and the opportunity cost of M1 in 1980 (for example), how much money should the public have been holding in that year?" This predicted level was then compared with the level the public was actually holding and the latter was found to be less than predicted—giving rise to the notion that money was missing. This is, however, just another way of saying that M1's velocity was higher than predicted. A simple example will explain why. If the public was making a given level of expenditures in 1980 with less M1 than was predicted, the velocity of M1 must have been higher than predicted. That is the only way this could happen. From our discussion above, M1's velocity in 1993 was about 5.4 whereas based on the level of the T-bill rate it was predicted to be about 3.4. Thus, missing money implies a higher than predicted velocity.

The Role of M1 in the Conduct of Monetary Policy

The growing conviction by influential Members of Congress that the acceleration in the inflation rate during the 1970s was caused by too much money (by excessive money growth relative to the growth in real output) led in 1975 to a resolution requiring the Federal Reserve to report its

objectives for money growth. Later, in 1978, this requirement was enacted into law in the Full Employment and Balanced Growth Act (popularly known as the Humphrey-Hawkins Act).[8]

As inflation during the 1970s accelerated into double digits, the Federal Reserve, under the leadership of Paul Volcker, announced in October 1979 new operating procedures emphasizing the growth of nonborrowed reserves as a means for controlling the growth of M1. Thus, M1 appeared to be elevated from an informational variable to an intermediate target variable. Not only did M1 have the desirable characteristic that its components were almost exclusively held to make transactions, but its velocity also had a very small variation about its trend rate of growth (remember that in 1979 only the rising portion of M1's velocity shown in **Figure 1** was known).

Whether M1 was in fact elevated to this role is unclear. At about this same time evidence began to accumulate that its velocity was unstable. In October 1982, as the deepest economic downturn since the Great Depression of 1929-1933 was nearing its end, the Federal Reserve began to de-emphasize M1 in its deliberations. By July 1987, the instability in M1's velocity was so apparent that the Fed announced at the Humphrey-Hawkins hearings that it would discontinue setting a target range for M1 growth.

Thus, M1 may have been used briefly as an intermediate target by the Federal Reserve. The instability in its velocity, however, diminished its usefulness as a target variable and, ultimately, robbed it of much of a role as an informational variable. Efforts to explain its instability will be reviewed below. In addition, during the period October 1979-October 1982, when M1 may have been used as an intermediate target variable, its growth rate on a quarterly basis was highly erratic, and market interest rates were much more variable than during the period when they were the focus of Federal Reserve policy (as might be expected). Why the erratic behavior of M1 growth occurred is unclear. Nevertheless, because of these developments, money market participants were among those voicing disapproval of Fed policy.[9]

The Humphrey-Hawkins Act also mandated the Fed to present semi-annual reports to Congress. A central feature of these reports were growth rate ranges for various measures of money and credit. However, beginning in the early 1980s, the Fed decided to discontinue setting a monitoring range for M1. In July 2000, a similar decision was made for the remaining aggregates.

The instability in M1's velocity need not imply that monetary aggregates have no role to play in the conduct of monetary policy. There are two other measures of money, M2 and M3. The theoretical basis made for using either as an *intermediate target* or *informational variable* comes from an alternative approach to defining money.

The Empirical Definition of Money (M2)

As noted above, the economics profession is not of one mind when it comes to the role of money in business cycles. Beginning in the 1950s, two economists, later to achieve great prominence in the profession, Milton Friedman and Anna Schwartz (among others), began to publish research

[8] This conviction that inflation was caused by an excessive growth of money was influenced by a similar conviction among an increasingly vocal number of economists. Known as monetarists, they came to occupy an important place in the economics profession in the 1960s and 1970s and their central thesis that excessive money growth causes inflation became a generally accepted view.

[9] There is substantial doubt that M1 was ever elevated to the status of an intermediate target variable. One reason for this doubt is that the Fed allowed base drift to occur. Base drift occurs when the ending value of M1 during a given period is used as the base for setting the growth rate target range for a subsequent period regardless of whether that ending value for M1 is other than the midpoint of the prevailing growth rate range. Over time, if base drift is not corrected, M1 growth (or the growth of any monetary aggregate) can be higher or lower than would have occurred if each new growth rate range was positioned at the mid-point of existing growth rate range.

findings designed to convince a then skeptical economics profession that money mattered and that variations in the growth rate of the money supply played a major role in causing business cycles. Crucial to this research was a definition of money or some empirical counterpart to the notion of money.

Friedman and Schwartz, in justifying their definition, state " ... we see no compelling reason to regard the literal medium-of-exchange function as the 'essential' function of the items we wish to call 'money'." After all, except for the moment in which money actually changes hands in a transaction (or is used as a medium of exchange), it remains inactive, or, in their words, is "a temporary abode of purchasing power." What such a collection of assets would be was not to be determined by logic. Rather, they sought a collection of assets, changes in the supply of or the demand for, which would allow them to readily and accurately predict the consequences for important economic variables such as nominal GDP.

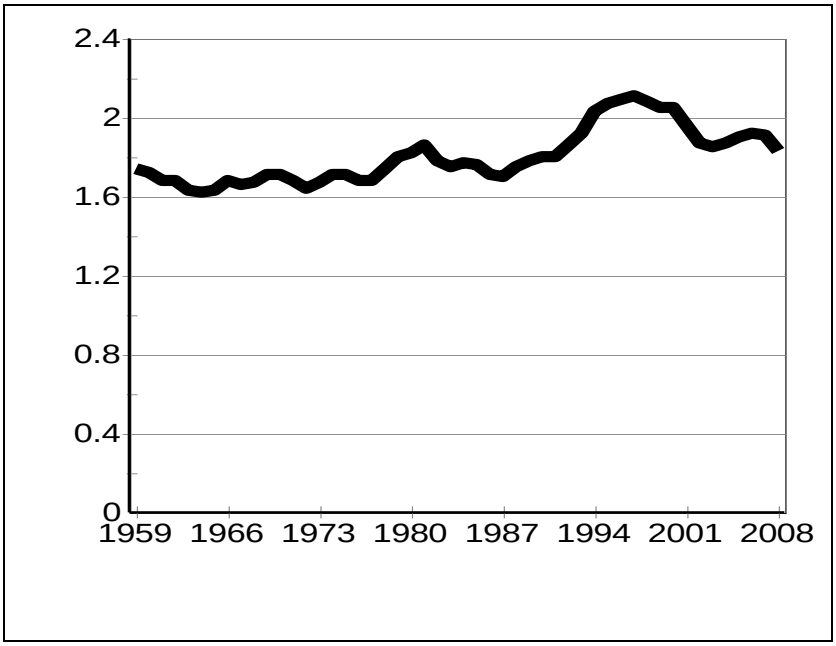
After much consideration, Friedman and Schwartz settled on what was then called M2.[10] M2, it should be noted, contains assets that cannot themselves be used directly as a medium of exchange. Nevertheless, in their studies, M2 was stable and predictably related to nominal GDP.[11] In addition, as shown in **Figure 3**, over most of the 1959-1988 period, the velocity of M2 displays no trend, varying between 1.62 and 1.75 (thus, it has the advantage of being a virtual constant with very small deviations from its average value).[12]

[10] As M2 was defined prior to 1980, it contained currency, non-interest paying demand deposits, and saving and time deposits (time certificates of deposit or CDs were not in existence during the period covered by the work of Friedman and Schwartz).

[11] The Friedman-Schwartz approach to money demand or velocity yields a model which is somewhat different from Baumol-Tobin. Since money holding is viewed as an alternative to both real and financial assets, its opportunity cost can be measured by such diverse factors as interest rates, the yields on stocks, and the expected rate of inflation (which measures the yield on goods). Velocity, however, rises as the opportunity cost of money rises as in the Baumol-Tobin model. The Friedman-Schwartz model suggests that money holding is linked to wealth (or its proxy, expected income) rather than to GDP.

[12] The velocity of the M2 used by Friedman and Schwartz has been computed by them for the period 1869 to 1960. It slowly declined from about 4.6 in 1869 to a range of about 1.5 to 1.7 during the decade of the 1950s. See Milton Friedman and Anna J. Schwartz, *A Monetary History of the United States 1867-1960* (Princeton, NJ: Princeton University Press, 1963), Table A-5, pp. 774-775. A factor in Friedman and Schwartz's selection of M2 as their preferred measure of money is that they wanted a longtime series on money so that they could examine its behavior over many business cycles. Prior to 1915, it is impossible to separate demand from other deposits on the books of U.S. banks. Thus, to examine the behavior of money over many cycles, M2 must be used.

Figure 3. The Velocity of M2



Source: Federal Reserve

The near constancy of M2's velocity attracted the attention of the Board of Governors, and it came to replace M1 as the preeminent informational variable in the conduct of monetary policy. During the 1980s and early 1990s, the deliberations of the Federal Reserve and the semiannual Humphrey-Hawkins monetary policy reports consistently used M2 as the basic money supply variable. Moreover, M2 was the basic measure of money used in the large-scale econometric model of the United States maintained by the Board of Governors of the Federal Reserve. M2, however, has not been used as an intermediate target variable.

Unfortunately, beginning late in the 1980s, the behavior of M2's velocity, like that of M1 a decade or so before, began to go off track. The relationship of M2 to its opportunity cost, established in the post-World War II period, could not explain the behavior of M2's velocity. While M2's velocity was expected to fall as interest rates declined in the 1990s, it actually began a sharp rise and reached its highest levels in the late 1990s. The M2 velocity values expected or predicted to occur based on historical experience were less that the actual M2 velocity that occurred. In terms of the alternative way of expressing this development used above, this was another case of "missing money." That is, based on GDP and the opportunity cost of M2, the public was holding less money than predicted. The same problem that had bedeviled M1 came to bedevil M2.[13]

Quite clearly this development caused consternation among the Board of Governors. In its semiannual monetary policy report to the Congress dated July 20, 1993, the Board for the first time expressed considerable uncertainty about the usefulness of M2 and M3 as informational variables. While the Board continued to set growth rate ranges for each aggregate, it concluded in that report:

[13] Since M1 is a component of M2, one might be tempted to ask why the instability in M1's velocity did not immediately lead to instability in M2's velocity. A popular answer was the "missing M1" was shifted into CDs. Since CDs are in M2, but not M1, this shift would have no effect on M2's velocity.

> With considerable uncertainty persisting about the relationship of the monetary aggregates to spending, the behavior of the aggregates relative to their annual ranges will be of limited use in guiding policy ... and the Federal Reserve will continue to utilize a broad range of financial and economic indicators in assessing its policy stance.

The continued uncertainty in the behavior of the velocity of M2 (and M3) led the Board of Governors to discontinue setting a monitoring growth rate range for both the M2 and M3 measures of money. This was announced at the Humphrey-Hawkins hearings held on July 20, 2000. Thus, M2 and M3 became just two of the many informational variables the Board uses in the formulation and execution of monetary policy. In November 2005, the Board of Governors announced that beginning in March 2006 it would no longer publish data on M3.

Does Either M1 or M2 Still Have A Role in Forecasting Economic Activity?

The data on **Table 1** established the fact that money (M2) and nominal GDP have a substantial degree of covariability (at least over the period 1959-1989). What was controversial about this finding was the implied cause and effect relationship.

A number of economists who believe that causality runs from changes in the money supply to changes in nominal GDP have argued that the stability of this relationship could be exploited for forecasting purposes. Knowledge of money growth could be used, for example, to forecast the growth of nominal and real GDP and the rate of inflation.

A good deal of analytical effort has been expended on this subject. Increasingly, these efforts have been focused on what is called "time series analysis." A central feature of this analytical tool is the so-called Granger test, named after Prof. Clive Granger, a pioneer in time series analysis. The essence of the Granger test is to see whether additional variables can add any extra information or predictive power to forecasting a focus variable that is not already contained in the history of the focus variable itself. If it can (as determined by a statistical test of significance), the added variable is said to "Granger cause" the focus variable or the variable whose value is being forecasted.

A seminal use of this methodology in the study of money's influence on economic activity was made by Prof. Christopher Sims in 1972. In this study, using quarterly data from 1947 through 1969, M1 was found to Granger cause nominal gross national product.[14] That is, although the history of GNP provided a good deal of information about the current and future values of GNP, this information was enhanced (or an improved prediction was possible) by also using the history of the growth of M1. Later, in 1980, Sims published the results of a more elaborate study using monthly data involving a possible Granger causality role for both M1 and the commercial paper rate.[15] When both were used simultaneously with the focus variable being the industrial production index, M1 no longer played a Granger causal role in explaining this measure of economic activity (i.e., its contribution to explaining the behavior of industrial production was no longer statistically significant). A major role was, however, played by the commercial paper rate. The sample period covered by this study ran from 1947 to 1978. What Sims may have picked up

[14] See Christopher Sims, "Money, Income, and Causality," *American Economic Review,* September 1972, pp. 540-552. Sims did not use the M2 measure of money in his study. He did, however, use, in addition to M1, the monetary base, which consists of bank reserves and currency in circulation. A Granger causality role for the monetary base was rejected.

[15] Christopher Sims, "Comparison of Interwar and Post-war Business Cycles: Monetarism Reconsidered" *American Economic Review,* May 1980, pp. 250-257.

in this study was the breakdown in the stability of M1's velocity—the extent of which was not too well documented in 1980.

Several subsequent studies using data from the 1980s and 1990s have come to inconclusive results on the Granger causal role of money. For example, a study by Friedman and Kuttner, incorporating quarterly data for the entire decade of the 1980s (their sample runs from 1970:3 to 1990:4), appeared to sound the death knell for all measures of money and credit then used by the Federal Reserve as information variables.[16] They could find no Granger causal role for the monetary base, M1, M2, or credit in explaining the movements of nominal and real GDP and the rate of inflation over their sample period. Various short term interest rates and the spread between the four-six month commercial paper rate and the 90-day Treasury bill rate (this difference being a measure of risk) did, however, play an important role in Granger causing or explaining the behavior of the three focus variables. Estrella and Mishkin reconfirm this conclusion in a later study. Using monthly data for the period 1960-1995, they reject even an informational role for the monetary base and M2.[17]

The conclusions of these studies have been disputed by several others. Using the same time period and data, but with a slightly different equation than Friedman and Kuttner, Feldstein and Stock concluded that the relationship between M2 and nominal GDP was sufficiently strong and stable to warrant further investigations into using M2 to influence spending.[18]

A 1992 study by Becketti and Morris, using quarterly data from 1970:1 through 1992:2, found a Granger causal role for M2 in explaining movements in real GDP when the observations from 1979:4 through 1982:4 were excised from the sample.[19] This was the period when the Federal Reserve supposedly abandoned interest rates as intermediate target variables and replaced them with monetary aggregates.[20]

Becketti and Morris concluded:

> The forecasts that ignore M2 failed to foresee the most recent recession (1989-1990) and predicted a much stronger recovery than has occurred.... The forecasts that included information on M2 also missed the recession, but they accurately predicted the weakness of the recovery since the second quarter of 1991....

Finally, Duca reported some promising results in which M2, expanded to include the dollars in bond mutual funds and bond and stock mutual funds, yielded better forecasts of nominal GDP growth over the 1990-1994 period than did M2 by itself.[21] However, the advantage of the two

[16] Benjamin M. Friedman and Kenneth N. Kuttner, "Money, Income, Prices and Interest Rates," *American Economic Review*, June 1992, pp. 472-492.

[17] It should be noted that monthly income data do not exist. Estrella and Mishkin construct a proxy series from the coincident economic indicators and the consumer price index. What role this alternative measure of economic activity plays in their conclusion is unclear. Arturo Estrella and Frederic Mishkin, "Is There a Role for Monetary Aggregates in the Conduct of Monetary Policy?" *Journal of Monetary Economics*, vol. 40, 1997, pp. 297-304.

[18] Martin Feldstein and James Stock, "The Use of Monetary Aggregates to Target Nominal GDP in Monetary Policy," in *Monetary Policy*, Gregory Mankiw, ed., (Cambridge, MA: NBER Studies in Business Cycles, vol. 29, 1994).

[19] Sean Becketti and Charles Morris, Federal Reserve Bank of Kansas City *Economic Review*, Fourth Quarter, 1992), pp. 65-77. They could find no Granger causal role for either M1 or the Monetary Base. Moreover, they report no results for any monetary aggregate and nominal GDP or the aggregates and the rate of inflation, both having been used as focus variables by Friedman and Kuttner.

[20] This finding is of some interest for supposedly during the period 1979:4-1982:4, M1, not M2, was the intermediate target variable.

[21] John V. Duca, "Would the Addition of Bond or Equity Funds Make M2 a Better Indicator of Nominal GDP?" Federal Reserve Bank of Dallas *Economic Review*, Fourth Quarter, 1994, pp. 1-14.

new monetary aggregates over conventional M2 was not large when the federal funds rate and the 10-year Treasury note yields are added to the forecasting equation.

Nevertheless, while these studies may have help us to understand the role of money in business cycles, they revealed that the results may have been highly sensitive to the focus variable used, the measure of money used, and the time period from which the data were drawn. At most, these results should have been regarded as suggestive in nature. As such, they suggest that at least M2 may have had continued value in providing some information about the future course taken by real GDP.

The Search for A Stable Velocity of Money

Efforts to Explain the Instability of M1's Velocity

The instabilities in the velocities of M1 and M2 did not go unnoticed. Chronologically, the instability of M1's velocity occurred first. Ironically, by 1973, the economics profession had accepted as fact that a stable velocity for M1 existed. A highly regarded study by Princeton economist Stephen Goldfeld established this fact.[22] Goldfeld estimated an equation in which M1's velocity depended on interest rates and income. This equation passed all the statistical tests of stability. Beginning in 1974, however, the Goldfeld equation began to seriously underpredict M1's velocity and thus overpredict the public's money holdings. This degree of error continued to grow over the decade. In 1976, Goldfeld published a study on the "missing money."[23] For the next several years the journals were filled with articles purporting to explain what had happened. Some sense of the magnitude of this effort can be gleaned from the fact that in 1982 two economists, Judd and Scadding, surveyed this outpouring for the *Journal of Economic Literature*. Their survey article contains 86 citations.[24]

The search for the cause of the instability had to confront a considerable number of innovations that had and were occurring in financial markets during the 1960s and 1970s that could reasonably have been expected to affect the velocity of M1.[25] These innovations were due in large part to banks, and resulted from a clash between rising market interest rates (documented in **Figure 2**) and banking regulations that forbade the payment of explicit interest on demand deposits and regulated those paid on saving and time deposits. If banks wished to remain major players as financial intermediaries, they had to come up with ways to pay interest to depositors or else risk the loss of funds and their role in the intermediation process.

[22] Stephen Goldfeld, "The Demand for Money Revisited," *Brookings Papers on Economic Activity*, no. 3, 1973, pp. 577-638. Rather than estimate directly a velocity equation, Goldfeld estimated a money demand or money holding equation. As noted above velocity and money demand equations are, however, equivalents.

[23] Stephen Goldfeld, "The Case of Missing Money," *Brookings Papers on Economic Activity*, no. 3, 1976. pp. 683-730.

[24] John P. Judd and John L. Scadding, "The Search for a Stable Money Demand Function: A Survey of the Post-1973 Literature," *Journal of Economic Literature*, September 1982, pp. 993-1023. In a follow-up survey on the instability of M1's velocity, published in 1991, Leventakis and Brissimis cite 109 articles. See John A. Leventakis and Sophocles N. Brissimis, "Instability of the U.S. Money Demand Function," *Journal of Economic Surveys*, no. 2, June 1991. pp. 131-158.

[25] It should be noted that as M1 was then defined, it consisted only of currency and non-interest bearing demand deposits. M2 consisted of M1 and savings and time deposits (the now popular time certificates of deposits or CDs were unimportant at this time).

The research efforts by economists tended to take one of two approaches, both of which were suggested by the Baumol-Tobin model (as modified by Miller and Orr).[26] The first approach continued to accept and use the then prevailing definition of M1. However, it was thought that the variables used to measure expenditures, broker fees, and opportunity costs were no longer adequate in light of the financial innovations and other changes in the economy. Thus efforts were made to reformulate or adopt new measures for some of these crucial explanatory variables.

Maintaining the Definition of M1

Because a major role for the breakdown of M1's velocity was believed to have had its origin in the demand deposit holdings of businesses, business practices with regard to these holdings came under close scrutiny. Important in this effort was a belief that banks were assisting businesses to better manage their money holdings, including standing ready to convert money holdings into interest earning securities on an overnight basis.

While finding a suitable empirical measure for these improved services proved difficult, those selected did seem promising at the time to capture this *structural* change in velocity. These improved cash management techniques were also thought to reduce the variability in the income and expenditure flows of businesses, thereby reducing their need for precautionary money holdings (as suggested by the Miller-Orr model).

In a similar vein, it was questioned whether gross national product (GNP) or some subdivision thereof was really an adequate proxy for those expenditures requiring money. GNP (and GDP) after all, includes capital consumption allowances and a number of imputations, neither of which require the use of money. In addition, GNP and its subdivisions exclude spending on financial and existing real assets. Nevertheless, so long as GNP (or GDP) moves in concert with total spending it would not have produced an unstable velocity. When this was not the case, it could affect the perceived stability of velocity. For example, if turnover in financial markets increases, money demand may have increased, all else equal. Because this increase in money holding did not affect income, measured velocity (PY/M) would fall for no apparent reason, and would appear unstable. There was a feeling that perhaps this was what had happened in the 1970s. After a long period in which income and transactions velocity were moving in concert, the growth in financial and asset transactions during the 1970s relative to income growth might have caused M1's velocity to appear to be unstable when in fact it was not. Efforts to find better measures of total spending, while promising, did not provide the answer to the instability.[27]

Changing the Definition of M1

The second line of inquiry suggested that since some of the innovations in financial markets consisted of new assets which were highly substitutable for the assets then included in M1, the definition of M1 should be changed. During the late 1970s and into the 1980s, the regulations placed on the interest rates depository institutions could offer on various types of deposits were

[26] An important modification of the Baumol-Tobin model made by Miller and Orr is to make income and expenditures probabilistic rather than certain. As a result, any innovations that reduce the possible dispersion of either can be expected to reduce the demand for money or raise velocity. See Merton Miller and Daniel Orr, "A Model of the Demand for Money by Firms," *Quarterly Journal of Economics*, vol. 80, August 1966, pp. 413-435.

[27] See, for example, Charles Lieberman, "The Transactions Demand for Money and Technical Change," *Review of Economics and Statistics*, vol. 59, August 1977, pp. 307-317; Jerred Enzler, Louis Johnson, and John Paulus, "Some Problems of Money Demand," *Brookings Papers on Economic Activity*, no. 1, 1976, pp. 261-280; and William Bomberger and Gail Makinen, "Money Demand in Open Economies: Alternative Specifications" *Southern Economic Journal*, July 1980, pp. 30-39.

relaxed. This deregulation undoubtedly altered the range of assets that could be regarded as substitutes for the assets in both M1 and M2.

Obvious choices were the interest-paying accounts then offered by State chartered mutual savings banks to households on which checks could be drawn—these were the NOW accounts and Super NOW accounts (and later share drafts offered by credit unions). By the mid-1970s, NOWs were authorized for most types of depository institutions in the northeastern part of the United States. However, since only households were able to hold NOWs at that time, they could explain only a small part of the shift in M1's velocity since a large part of the problem was thought to be due to the sudden decline in the demand deposit holdings of businesses.

Perhaps one of the most innovative explanations for the instability involved a new arrangement banks had developed for paying interest to business customers, the so-called *repurchase agreement* (or REPO). This involves a bank selling an asset for a fixed period with the promise to repurchase it at a fixed price. The REPOs could be for a very short time indeed—overnight in fact. Garcia and Pak made an interesting argument that banks allowed their business customers to use their demand deposits during the day and, just before closing, would sell them REPOs on an overnight basis.[28] Thus, business demand deposits would be understated at the end of the day by the amount of REPOs. When the REPOs were added to M1, they accounted for much of the so-called missing money. Subsequent research, however, cast doubt on the role REPOs were thought to have played in the decline in M1s velocity.[29]

One aspect of the search for the missing money was to reopen the debate about the appropriate definition of money. The fact that the velocity of M2 had all the statistical properties of stability did not go unnoticed. Moreover, the equation used to predict M2's velocity for forecasting purposes, neither over- nor underpredicted it. It thus appeared that the velocity of M2 was immune to the changes in financial structure, financial innovations, and the deregulation of banking that had taken place during the 1960-1980 period. M2 then became the primary informational variable for monetary policy.

Nevertheless, research continued into the causes of the instability of M1's velocity—including the velocity of the augmented M1 for all NOW accounts, share drafts and the like were included in the new definition of this aggregate announced by the Federal Reserve in 1980.[30] Perhaps the final act in this research drama was played in 1992 when Duca presented evidence that the major reason for the weakness in business demand deposit holdings had to do with interest rates and compensating balances.[31]

When businesses borrow from banks, they are generally required to hold certain deposit balances at those banks—so-called compensating balances. These balances can be an important fraction of total business demand deposits. A Federal Reserve survey of 60 large banks in 1987, for example, suggested that roughly half of all business demand deposits were, in fact, compensating balances. As interest rates rose during the 1960s and 1970s, compensating balances became more costly for businesses, even though banks tried to pay interest on them implicitly. Duca argue that, as a result, an increasing number of businesses incurred the set-up costs for borrowing directly in the

[28] See Gillian Garcia and Simon Pak, "Some Clues in the Case of the Missing Money," *American Economic Review*, May 1979, pp. 330-334.

[29] This practice would not affect the velocity of M2, however, because the money market accounts are included in M2.

[30] It should not be forgotten that these changes to the definition of M1 also required a redefinition of the opportunity cost of money. Redefinition of opportunity cost was also an important part of the research effort highlighted above in which the old measure of M1 was maintained.

[31] John V. Duca, "U.S. Business Credit Sources, Demand Deposits, and the 'Missing Money'," *Journal of Banking and Finance*, vol. 16, 1992, pp. 567-583.

commercial paper market rather than borrowing indirectly using banks as intermediaries. This shift to direct borrowing brought about a marked decline in compensating balances and, thus, in business holdings of demand deposits. This decline, Duca's evidence suggested, explains much of the "missing money."

An equally serious problem arose from the increasing popularity of the U.S. dollar as an international currency. Dollars are held by foreigners as a hedge against an uncertain political and economic future, to finance illegal activities (the narcotics trade), and as a currency for conducting legitimate business (as in Ecuador). Estimates (using only $100 denomination bills) suggested that this sum had risen from about 10% of the total in the early 1970s to about 50% in 2001.[32] This overstatement is not small. In 2001, currency was more than 50% of recorded M1. Thus, the recorded data on M1 progressively overstated the amount of M1 that was used for spending in the United States.

Summary of M1

The stability displayed by the velocity of M1 through the early 1970s gave rise to a view among some economists that M1 could be used as an intermediate variable for the conduct of monetary policy as well as providing a good deal of information about the likely course to be taken by aggregate demand and economic activity. This optimism was shaken by the apparent instability of M1's velocity that appeared in the early 1970s and continued for some years thereafter. Research identified several factors as responsible for this instability. First, structural changes occurred in the financial environment that determined velocity. These changes were due in part to the growing sophistication of the economy and the financial intermediaries that it created and to changes in the legal environment that governs intermediaries.[33] Second, changes in the nature and availability of substitute assets for money can both alter the opportunity cost and create measurement problems for M1. Third, the use of American currency abroad created problems for measuring the effective amount of M1 that circulated in the U.S. as well as the other aggregates of which it is also a part. Finally, there could be a series of one time and largely transient events that could alter the velocity of money. A prominent one, analyzed below, was the thrift and banking crisis of the mid-1980s (as well as the Asian and Russian crises of the late 1990s and the U.S. financial crisis that began in the summer of 2007).

Efforts to Explain the Instability of M2's Velocity

The velocity of M2 proved to be quite stable during the 1980s and, without doubt, it became the preeminent informational variable for the Board of Governors. The semiannual monetary policy reports make ample reference to the behavior of M2 and its velocity compared with other measures of money and credit.

This happy state of affairs did not last. The velocity of M2 began to rise in 1990 when the standard estimating equation predicted it would fall. As in the case of M1, the problem with M2's velocity was phrased in terms of the missing money. Moreover, the economic expansion that got underway in March 1991 appeared to have been set in motion and sustained with no help from M2. In fact, given the behavior of M2, it was doubtful that any expansion would have occurred, much less been sustained.

[32] For more information, see CRS Report RL30904, *Why Is the Amount of Currency in Circulation Rising?*, by Marc Labonte and Gail E. Makinen.

[33] For an account of the interaction of economic growth and financial intermediation, see John Gurley and Edward Shaw, *Money in a Theory of Finance* (Washington, DC: Brookings Institute, 1960).

It is now widely acknowledged that the weakness in M2 growth (or the missing money) is tied to three of its components: currency, much of which circulates abroad, money market mutual fund balances, and time certificates of deposit (CDs), especially the latter.

As with M1, an extensive research effort was undertaken to find the missing money or explain the perverse movement in M2's velocity. While some of it was found, the results of this effort were largely inconclusive (i.e., only some of the instability in M2's velocity was reduced). It was still too unstable, or the research too tentative, for M2 to be considered an intermediate target variable and, of course, the instability, though reduced, did little to enhance the informational value of M2. In general five explanations were put forth to account for the missing M2.

Adding Assets to M2

Some economists tried to account for the effect of financial innovation on M2. It was noticed that the "missing money" coincided with the rapid growth of bond and equity mutual funds. An argument was made that these funds were very good substitutes for the savings accounts and CDs supplied by banks and, therefore, should have been included in an augmented M2. Some studies used such an augmented M2 and found that its velocity was more stable than for conventional M2. Among the studies opting for the expanded monetary aggregate, Duca reported that he was able to account for more than 40% of the missing M2.[34] However, a problem with augmented M2 was that, unlike the assets in conventional M2, bond and equity funds were subject to capital gains and losses. These gains and losses changed the value of M2 independent of changes in its opportunity cost, making velocity appear to be unstable.

Reduced Transactions Costs

Transactions costs, or the cost to buy and sell assets, play a role in the Baumol-Tobin model of money demand. If those costs decline, the model predicts that individuals will hold less money or that velocity will rise. The introduction of bond and equity mutual funds was thought to have made this possible. In some cases, bond mutual funds became part of a family of mutual funds offered by banks which allowed depositors, at low transactions costs, to transfer funds from bond funds to money market mutual funds on which checks can be written. Failure to account for this fall in transactions costs was one element thought to account for missing money.[35]

Additional Opportunity Costs

The third explanation was to some degree complementary with the first. It had to do with interest rates, the spread in interest rates, and deregulation. As the interest rates banks could pay on their various deposits were deregulated, it was argued, these deposits became better substitutes for a variety of other earning assets such as stocks and bonds. Failure to account for this change was believed to be responsible for some of the missing money. The economists taking this line advocated altering the opportunity cost variable in the standard velocity estimating equation. In particular, they urged that the yields on both short and long term assets be included in the

[34] John V. Duca, "The Case of the Missing M2," Federal Reserve Bank of Dallas *Economic Review*, Second Quarter 1992, , pp. 1-24; and "Should Bond Funds Be Added To M2?" *Journal of Banking and Finance*, vol. 19, 1995, pp. 131-152.

[35] Duca presented evidence that movements in the costs of taxable bond funds made possible by new technologies explained much of the movement in M2's velocity during the early 1990s. See John Duca, "Financial Technology Shocks and the Case of the Missing M2," *Journal of Money, Credit, and Banking*, vol. 32, November 2000, pp. 820-839.

equation (less the interest that was paid on the assets in M2). The spread between long and short term interest rates supposedly captured the ability of the bond and stock funds to attract dollars from, or divert those that were intended to go to, depository institutions (this was due to the fact that bond funds could hold longer term assets and, as the spread widened, offer higher rates than could depository institutions on their CDs).

Among those studies using either multiple opportunity costs or the addition of a spread variable was that of Feinman and Porter.[36] Estimating equations that add either multiple interest rates or a spread variable (they use the spread between the 30-year Treasury bond yield and the 3-month Treasury bill rate), they reported that they found more than two-thirds of the missing M2.

The Thrift and Banking Crisis

A fourth explanation for the missing money was related to the thrift and banking crisis of the mid-1980s and weakness in the sector in the early 1990s. Adjusting M2 velocity for this one-time event took several routes. The first built upon the activities of the Resolution Trust Corporation (RTC). Its activities, it was argued, made the yields on CDs more uncertain. It did this because in dealing with failed thrifts, the RTC would either pay off the CD holder or transfer the CD to the merging or purchasing institution which had the option of repricing the CD. Since many CDs in failed institutions were higher yielding than at acquiring institutions, this increased the uncertainty of CD yields. An attempt was made to incorporate this increased uncertainty into the standard equation explaining velocity. It should be noted that the activities of the RTC were not expected to have a lasting effect on M2's velocity. This was, in essence, a one-time effect. Once the RTC had completed its activities, M2's velocity was expected to be governed by only its systematic determinants (e.g., opportunity cost, brokerage fees, and income).

Using conventional M2, Duca, after incorporating a measure of this uncertainty in a standard estimating equation for velocity, was able to explain what happened to 83% of the missing money. When M2 was augmented by adding bond and equity mutual funds, the addition of the RTC uncertainty variable enabled him to account for 95% of the missing money.[37] Carlson and Parrott, also used conventional M2, reported that they are able to account for much of the missing money when their variable accounting for RTC activities was added to a standard M2 velocity equation.[38] Their study, unfortunately, did not include data from most of the 1990s.

Orphanides and Porter's approach was somewhat different. First, they purge the conventional measure of M2 of currency that circulated abroad and an estimate of money that was tied up as collateral in mortgage-backed securities pools. The velocity computed from their modified M2 was related to the capitalization of banks, revisions of stock market earnings, the liquidity of Treasury securities, the term spread on Treasury yields, and stock market volatility. They report that this velocity is stable enough that their reconstituted M2 is a good informational variable.[39]

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[36] Joshua Feinman and Richard D. Porter, "The Continuing Weakness in M2," Finance and Economic Discussion Series Working Paper No. 209 (Federal Reserve Board: September 1992).

[37] *Ibid*.

[38] John B. Carlson and Sharon E. Parrott, "The Demand for M2, Opportunity Cost, and Financial Change," Federal Reserve Bank of Cleveland *Economic Review*, Second Quarter 1991, pp. 2-11. In this study, the change in thrift deposits is added to the velocity estimating equation as a proxy for the change in opportunity cost brought about by the RTC restructuring activities.

[39] Athanasios Orphanides and Richard Porter, "Making Sense of the Monetary Aggregates," preliminary draft, Federal Reserve, December 2001.

Lown, Peristiani, and Robinson accounted for the problem related to the banking and thrift crisis by constructing a new M2 series. This consisted of the M2 that would have occurred if it had been supplied only by well capitalized banks and thrifts. They found that the velocity derived from this new series was stable and argued that their modified M2 contained useful information about economic growth.[40]

Structural Changes

A fifth approach was to argue that there was an acceleration in long term structural changes that affected the intermediation process in the United States during 1990-94 that further diminished the role of commercial banks as intermediaries. As a result, the same or a greater amount of spending took place in the economy with less money. This would have appeared as a rise in M2's velocity unrelated to a change in income or its opportunity cost. A major reason for the diminished role of banks as intermediaries, it was argued, was the removal of the subsidy given them by the federal government.

The nature of the subsidy was in the provision of deposit insurance at rates that bore little relation to the riskiness of the assets that banks had acquired. Moreover, deposit insurance made it possible for these institutions to get by with capital accounts that in many cases were also unrelated to the riskiness of the assets.

Changes in deposit insurance premiums and the imposition of risk based capital standards have made it more costly for banks to lend. As a result, borrowers have sought funds by borrowing directly from lenders or from other intermediaries (e.g., insurance companies, pension funds, etc) rather that indirectly through banks. The decline in the banking sector's share of lending was matched, it was argued, by the run off of CDs—the principal managed liability of banks.

Summary of M2

The research agenda to find the missing M1 was simply extended to find the missing M2 when its velocity became unstable in the early 1990s. It involved redefining M2, redefining the opportunity cost of M2, accounting for changes in the institutional setting determining M2 velocity, and factoring in any number of changes essentially of a one time nature to account for the resolution of the thrift and banking crisis of the mid-1980s.

While much of this research was fruitful in fostering our understanding of the role of the financial system in the economic health of the nation, it failed to make much of an impression on the published reports of the Board of Governors and did not prevent the Board from discontinuing the setting of growth rate ranges for the monetary aggregates. In large measure this was due to the variety of results that have been obtained. (Contrast, for example, the findings of Duca with those of Feinman and Porter. Each purported to find much of the missing money with quite different approaches).[41]

[40] Cara Lown, Stavros Peristiani, and Kenneth Robinson, "What Was Behind the M2 Breakdown?" Federal Reserve Bank of New York, Working Paper, July 1999.

[41] It should be noted that the velocity instability experienced by the U.S. also occurred in some other countries. It was so pronounced in Canada that the Canadian central bank discontinued using monetary aggregates as intermediate target variables. See James Boughton, "Recent Instability of the Demand for Money: An International Perspective," *Southern Economic Journal*, vol. 47, January 1981, pp. 571-597.

Other Efforts to Redefine Money

Before concluding this discussion it is worth reporting on two other efforts to construct new monetary aggregates that were theoretically consistent. The first was the effort by Professor William Poole, a recently retired president of the Federal Reserve Bank of St. Louis.[42] Poole drew his inspiration from Friedman and Schwartz's definition of money as a "temporary abode of purchasing power." For Poole, these were assets "that can be accessed without notice and at par." He called assets that have these characteristics assets of zero maturity. All assets which were then in M2 were zero maturity assets except CDs, which had a fixed and positive term to maturity. Should they be cashed before maturity, their holders would incur a penalty. Thus, their face and conversion values differed. However, Institution Only Money Market Funds, included in what was then M3, had the zero maturity characteristic. Poole proposed to gather all these zero maturity assets into a common aggregate called MZM (Money with Zero Maturity).

Carlson and Keen examined the stability of MZM in the early 1990s.[43] They found that over the period 1975-1995 the velocity of MZM could be explained very well by its opportunity cost, particularly by movements in interest rates. Since the opportunity cost of MZM over this period varied from about 1% to 12%, MZM's velocity was highly variable, rising from about 2.5 in 1975 to 3.4 in 1980 and back to 2.5 in 1995. Thus, knowledge of the movements in MZM by itself would have been unlikely to have provide consistently good forecasts of the probable course taken by money spending in the absence of good forecasts of the movements in interest rates.[44]

This was borne out by experience in the 1990s. While the growth rate of MZM decelerated prior to the peak in economic activity in July 1990 and began to accelerate prior to the cyclical trough in March 1991 (as might be expected if money leads or causes nominal GDP and velocity is stable), its growth rate during 1991 and 1992 was very high relative to the shallow recovery that took place. Moreover, the sharp decline in its growth rate in 1993 and 1994 would lead one to expect a sharp decline in the pace of economic activity which did not occur. Unless one had been able to accurately predict the course of interest rates from 1991-1994, MZM would not have been a useful informational variable over this period. However, the pace of MZM growth accelerated noticeably from early 1995 to early 1999, a period of very high growth of real GDP.

A second approach to defining money was through the development of what are called Divisia indexes. The notion behind these indexes, as applied to monetary aggregates, was that the conventional way of defining M2 or any monetary aggregate was likely to be flawed. When a collection of assets is put together as a monetary aggregate, an implicit assumption was made: all of the assets in the aggregate were perfect substitutes for each other. That is, they all yielded identical money services to their perspective holder. This was unlikely to be true, especially for the broader aggregates.

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[42] William Poole, Statement Before the Subcommittee on Domestic Monetary Policy of the Committee on Banking, Finance and Urban Affairs, U.S. House of Representatives, November 6, 1991, pp. 7-11. Poole has also analyzed the behavior of a variable called expanded M2 (M2 plus Institution Only Money Market Funds). See also Brian Motley, "Should M2 be Redefined?" *Economic Review*, Winter 1988, Federal Reserve Bank of San Francisco, pp. 33-51.

[43] John Carlson and Benjamin Keen, "MZM: A Monetary Aggregate for the 1990s?" Federal Reserve Bank of Cleveland *Economic Review*, Second Quarter 1996, pp.15-23.

[44] This was contrary to the case of M2 as an informational variable. Since the velocity of M2 was much less sensitive to movements in its opportunity cost, a fairly good forecast of the probable course to be taken by money spending could be gleaned from observing the recent growth rate of M2 itself. However, as noted earlier, the stability of M2's velocity broke down, and Carlson and Keen were unable to explain the movements in M2's velocity by movements in its opportunity cost in the 1990s, as they could do for MZM.

A Divisia index results when the various components of an aggregate were weighted by their degree of "moniness." Defining moniness and assigning the weights are complex and technical matters. Nevertheless, it could be done and the results were Divisia M1, M2, and M3.[45] For each of these aggregates, a related velocity could be computed in exactly the same way as with the conventional Ms.

Unfortunately, these velocities proved to be unstable. Thus, aggregates which were constructed to meet rigorous index number tests and were also theoretically consistent in the sense that each component supplied identical monetary services to its holder did not yield stable velocities. However, in forecasting real GDP and prices, the Divisia aggregates generally outperformed their simple non-Divisia counterparts.[46]

Uses of the Alternative Measures of Money in the Conduct of Monetary Policy

Two roles have been identified for the conventional monetary aggregates in the conduct of monetary policy: intermediate target variables and informational variables. At least three new monetary aggregates were suggested by the discussion above: MZM, Divisia money and M2 plus dollars in bond and stock mutual funds (M2+). Could these aggregates play either or both of the above roles?

If the velocity of all three aggregates had been stable and predictable, it would have been possible that MZM could have been an intermediate target variable. The Federal Reserve could have controlled it with no more difficulty than it controlled M1 or M2. It is doubtful that either M2+ or the Divisia measures could have serve as an intermediate target variable since the Fed would have had much greater difficulty controlling them.

All three money measures could potentially have served as useful informational variables. Their usefulness in this role would have been enhanced by stable and predictable velocities. On the basis of the then current evidence, M2+ seemed more suited to this role than the others—even though the Fed's ability to control this aggregate would appear to have been more difficult than for MZM, for example.

The Conduct of Monetary Policy and the Money Supply

Thus far, this report has discussed the link between the money supply and economic activity and chronicled the efforts to explain the breakdown in the link. But ultimately, this exercise was useful to policymakers only in so far as it affects the conduct of monetary policy. The remainder of the report discusses different ways that the money supply relates to (or could alter) the execution of monetary policy.

Can the Federal Reserve Control the Money Supply?

It has been established that for the supply of money to be useful in the conduct of monetary policy, it must have a stable relationship to money spending such that, given any change in the

[45] For pioneering work in this area, see William A. Bartnett, "Economic Monetary Aggregates: An Application of Index Number and Aggregation Theory," *Journal of Econometrics*, vol. 14, September, 1978, pp. 11-48; and "Developments in Monetary Aggregation Theory," *Journal of Policy Modeling*, vol. 12, Summer 1990, pp. 205-257.

[46] Donald Schunk, "The Relative Forecasting Performance of the Divisia and Simple Sum Monetary Aggregates," *Journal of Money, Credit, and Banking*, May 2001, pp. 272-283.

money supply, policymakers can predict with reasonable certainty the subsequent change in money spending. In this discussion, it was taken as a given that the Fed could closely control the growth of the money supply if it so desired.

This raises the question as to whether the Federal Reserve can in fact control the money supply over a reasonably short period of time, say on a quarterly basis. In other words, do open market operations lead to direct and predictable changes in some measure of money, say M2? Lack of control is not due to an absence of timely data on M2. Orphanides and Porter reported that during the 1990s, the Board of Governors received micro data on over 92% of the components of M2 with a lag of eight days.[47]

An answer to this question must begin with the observation that the Federal Reserve does not directly control the various measures of money discussed in this paper. What the Federal Reserve controls are the reserves available to depository institutions (mainly commercial banks) on the basis of which they can make loans and buy assets and, in the process, create money and expand credit.

However, there are two other groups that can play an important role in determining how much money is created: individuals (households, business firms, and other financial intermediaries), and the banks themselves. Individuals decide how they wish to hold their wealth and assets (currency, demand and saving deposits, MMDAs, CDs, stocks, bonds, etc.). These decisions determine the composition of any aggregate identified as money (e.g., M1, M2, M2+, MZM).

Banks themselves can play an important role in determining their own liabilities (whether they take the form of demand or savings deposits, CDs, or MMDAs). In the process, a given dollar of reserves supplied by the Federal Reserve can result in a different amount of M2, for example. This arises because the reserves banks hold for their various liabilities are not uniform. The law requires reserves of approximately 10% for demand deposits. No legally required reserves are specified for the other types of liabilities and banks typically hold lower reserves for them. Since reserves are typically held in a currency or non-interest earning form, banks have an incentive to minimize their liabilities in the form of demand deposits. This incentive increases as interest rates rise.[48]

The crucial point is that the ability of the Federal Reserve to control money depends on the relationship of bank reserves and money. If the relationship is tight over a relatively short period of time, the Fed can be said to control the money supply. And control is necessary to use the money supply in the role of an intermediate target. It would appear that for some of the measures of money proposed above, control would not be very tight. If this is the case, sharp and unpredictable swings in bank reserves would be required for the Fed to control the money supply, and this would place a considerable hardship on the banking sector. This would not preclude those measures of money from performing an informational role.[49]

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[47] Athanasios Orphanides and Richard Porter, "Making Sense of the Monetary Aggregates," preliminary draft, Federal Reserve, December 2001.

[48] Recently, the Fed has been given permission to pay interest of the reserve holdings of banks, both required and excess. It is too early to access how this change has affected bank reserve holdings. With the onset of the financial crisis in the summer of 2007, the reserve holding behavior of banks has changed in an unprecedented way. Between December 2007 and December 2008, the reserves of banks have increased from $42.7 billion to $821billion. Of these $821 billion, only $53.5 billion were required to secure their deposit liabilities. The remainder were excess and, potentially, could be lent in credit markets.

[49] For a discussion of the ability of the Federal Reserve to control M2, see Daniel L. Thornton, "Targeting M2: The Issue of Monetary Control," Federal Reserve Bank of St. Louis *Review*, July/August 1992, , pp. 23-35.

Rule-Based Monetary Policy and the Money Supply

Suppose that a measure of money is shown to be stable and predictably related to money spending and that the Federal Reserve can, by manipulating bank reserves, control this measure of money on a timely basis. How should it conduct monetary policy?

An early answer to that question was provided by Friedman and Schwartz. Looking at the evidence from the early years in **Table 1** and from **Figure 3** (which was available at the time they wrote) they argued that since the velocity of M2 was a near constant, a steady growth of money spending could be maintained by a constant rate of growth of M2. They concluded that *discretionary* monetary policy as practiced by the Board of Governors should be replaced by a *rule* based policy: M2 should grow by whatever fixed rate was required to keep the price level constant. The historic evidence they had available suggested that since real output grew on average about 3% per year, price stability could be maintained by keeping M2 growing at the same rate.[50]

Implicit in this rule was an assumption that is often overlooked: that the dominant cause of cyclical instability in the U.S. is due to an erratic rate of growth of the money supply. Thus, if money growth could be stabilized, Friedman and Schwartz argued, most of the cyclical instability could be eliminated.

What happens if this monetary theory of business cycles is not true? Suppose instead, that, while the Federal Reserve could control the supply of money, cyclical instability was due to such factors as business expectations about the future profitability of their capital outlays? Such a belief gave rise to an argument for monetary *fine tuning*. In this framework, *discretionary* monetary policy was seen playing a stabilization role—the Federal Reserve would vary the growth rate of the money supply in a way to offset changes in money spending that originated in the private sector due to changing expectations. This view of business cycles seems prevalent with the Federal Reserve's Federal Open Market Committee, which has always used and supported discretionary policy.

For discretion to work effectively, timely decisions have to be made and the lag between those decisions and subsequent changes in aggregate spending have to be predictable. In particular, to work as intended, the major cause of cyclical instability must be due to changes in private sector spending unrelated to shifts in the money supply, the Federal Reserve must be able to recognize these changes and act upon them in a timely fashion, and the lag between Federal Reserve action and the economy's spending response must be predictable. If that is not the case, it strengthens the case for a rule based regime, although not necessarily one based on money growth. Faced with mounting evidence of the instability of money velocity, some rule proponents have shifted their support towards rules based on interest rates instead of money growth.[51]

Thus, the ability of the Fed to control the supply of money in a timely fashion does not necessarily lend itself to a rule based policy. Using the money supply as an intermediate target can equally well be applied to discretionary policy, just as an interest rate target can equally well be applied to a rule-based policy. Of importance is the cause of cyclical instability.

[50] A growth rate rule could have been derived from the behavior of M1 as well. Given the trend rate of growth of its velocity over the period 1959-1970, about 3%, price level stability could have been achieved by holding the M1 stock of money approximately constant.

[51] For more information, see CRS Report RL31050, *Formulation of Monetary Policy by the Federal Reserve: Rules vs. Discretion*, by Marc Labonte.

An Alternative to the Ms as an Indicator of Monetary Policy

If the instability of the velocity of money makes the currently defined monetary aggregates both undesirable intermediate targets and of limited usefulness as informational variables, there remains the possibility that interest rates might perform these roles.

The reason for using interest rates in these roles is that they are an important channel by which changes in monetary policy cause changes in spending. Essentially, with all else constant, an acceleration in the growth of bank reserves sets in motion a fall in interest rates and a raises in household and business spending on interest sensitive goods. Alternatively, when reserve growth is decelerated, interest rates rise and interest sensitive spending is curtailed. In this framework, rising interest rates are taken as a sign of "monetary tightness" while falling rates are a sign of "monetary easing."[52]

Thus, movements in interest rates could be used to control total spending and they could provide useful information about monetary policy and the future course of economic activity. And, indeed, the Fed has used interest rates in these roles. There is no doubt that, except possibly during the brief period October 1979 to about October 1982, the Federal Reserve has used interest rates as intermediate targets. In recent years this has meant controlling the federal funds rate and, through it, a range of short term interest rates. Moreover, the Federal Reserve has given interest rates an important informational role in communicating the posture of monetary policy to the public.

Such a role for interest rates is suggested by a widely used macroeconomic model when there is instability in the velocity of money.[53] However, the interest rates suggested by economic theory as relevant are not the rates used by the Fed. Economic theory suggests that real interest rates (or market rates less the *expected* rate of inflation) are the link from money supply changes to changes in spending and economic activity.

Even if the expected inflation rate could be calculated, the resultant real interest rates would not necessarily be a good informational variable about monetary policy. The reason is that other factors can influence the real rate independent of Federal Reserve action. Important among these other forces is the budget position of the federal government. It is generally acknowledged that the 1980s was a decade of high real interest rates. These were not due to a policy of tight money, but rather to the unprecedented large peacetime federal budget deficits. Thus, the high real interest rates of the 1980s convey little useful information about monetary policy and may be a very poor means for forecasting the future state of the economy.

Real interest rates can also be influenced by at least two other factors. First, the pace of economic activity can cause the real rates to vary. During economic upswings, real rates are thought to rise and to fall during slumps. Second, since capital flows between major countries with considerable ease, developments in foreign countries can affect real interest rates in the United States and vice versa. Thus, since rising or falling real rates may be due to the budget position of the federal government and cyclical and international factors, they may tell us little about the stance of monetary policy.

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[52] With the onset of the financial crisis in the summer of 2007, this traditional means by which monetary policy works appears to have broken down or, as a minimum, is temporarily inoperative since a huge addition of reserves is not being lent out.

[53] See William Poole, "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model," *Quarterly Journal of Economics*, vol. 84, May 1970, pp. 197-216. Technically, this choice is correct only if investment demand is more stable than velocity.

Alternatively, using *market* or nominal interest rates as an informational variable does not get around the problem with real rates since nominal rates can move with real rates. Additionally, their behavior is substantially influenced by expectations of inflation. Since it is, an easy monetary policy can, paradoxically, lead to high market interest rates. This can happen if monetary easing causes the public to fear that the inflation rate will accelerate. Similarly, a tight monetary policy can lead to low market interest rates if, as a result, the public comes to expect the inflation rate to decline.

For all these reasons, the informational content about the posture of monetary policy that comes from either market or real interest rates may be very little. Movements in interest rates must be read with great care if they are to provide any information about monetary policy.

Consequences of Ambiguous Indicators for the Conduct of Monetary Policy

It is now widely accepted that monetary policy is a powerful tool in the short run for affecting the pace of economic activity and employment and, over the longer run, the rate of inflation.[54] Moreover, in the present international monetary system, it is a more powerful tool than fiscal policy. Thus, for those exercising oversight responsibilities for monetary policy, it is both imperative and desirable that they have the most objective and unambiguous possible indicator of that policy.

With monetary aggregates that convey little information about monetary policy and interest rates that can be equally devoid of information, those exercising oversight are left in the position of having to rely heavily on the nation's central banker as the conduit of information about and judgments on the policy that he or she is responsible for formulating and executing. From an oversight perspective, this is unlikely to be a healthy situation and one conducive to an arms length evaluation of monetary policy.

Moreover, without unambiguous indicators of monetary policy, those formulating policy are more likely to rely on current developments in the economy in making their decisions on what policy should be even though the effects of that policy may be felt at some distant time, perhaps as long as two years in the future. "Don't fire until you see the whites of their eyes" may have been good advice on the field of battle during the Revolutionary war, but it is not good advice for the conduct of monetary policy. By the time you see the "whites of their eyes," it is long past the time when policy initiatives should have been undertaken.

Nevertheless, one must contend with the fact that monetary policy seems to have been quite successful over much of the past 25 years. Between the early 1990s and 7007, the United States has had only two short and shallow downturns. On the basis of this record, a case might be made that central banking is an art and its success depends crucially on the abilities of the central banker. Alternatively, it might be argued that the Federal Reserve had an incredible run of good luck. It managed to steer a ship with two compasses that often fail to yield unambiguous readings.

[54] As noted above, the massive increase in bank reserves between the end of 2007 and 2008 have not been lent out and suggest the monetary policy may temporarily be unable to bring about changes in spending in the short run. This has been disputed by former Fed governor, Frederic Mishkin who argues that without the aggressive monetary action by the Fed, conditions in the nation's financial markets would have been much worse. See Mishkin, Frederic S. "Is Monetary Policy Effective During Financial Crises?" Draft, December 2008.

Conclusion

For some three decades, the United States has seen rapid changes in its financial system. These changes have been spurred in part by a clash between rising interest rates and regulations that inhibited banks from being competitive players in financial markets. The desire to survive as intermediaries motivated them (and other depository institutions) to innovate ways to get around these regulations. This involved finding ways to pay interest to depositors and potential depositors. In some cases this meant bringing into being new types of financial instruments such as NOW accounts, money market accounts, money market mutual funds, and repurchase agreements.

Gradually, governments came to realize that the interest rate regulations were counterproductive if not harmful. Deregulation of interest rates made bank deposits better substitutes for a variety of other financial instruments.

It should come as no surprise that these changes have had an effect on the velocity of various measures of money. Trying to explain what these effects have been and how to adjust to them has been part of a large and ongoing research effort involving the specification of new monetary aggregates, new measures of opportunity cost and risk, and new measures of total spending. In addition, a host of technical issues related to econometric estimations of velocity equations have arisen and been dealt with.

Because of the continued instability in the velocities of the conventionally defined aggregates and the tentative and unsettled nature of much of this research, it has not been possible to use the existing or newly formulated monetary aggregates as intermediate control variables. Moreover, their role as preeminent information variables is also limited. It may, nevertheless, be desirable to continue to monitor the existing aggregates and some of the new ones that have demonstrated promise for forecasting such relevant economic performance variables as nominal GDP.

In addition, interest rates can play a potentially useful information role. However, since their movements are subject to influences other than the Federal Reserve, their movements must be interpreted with great care.

Glossary: Definitions of the Aggregates

M1 is the sum of the following:

1. Currency held by the public
2. Outstanding traveler's checks of nonbank issuers
3. Demand deposit balances
4. Negotiable Order of Withdrawal (NOW and Super-NOW) accounts and other checkable deposits.

M2 is the sum of the following:

1. M1
2. Time and savings deposits in amounts under $100,000
3. Individual holdings in money market mutual funds
4. Money market deposit accounts (MMDAs).

M3 is the sum of the following:

1. M2
2. Time deposits at commercial banks in amounts of $100,000 or more
3. Term repurchase agreements
4. Institution-only money market mutual funds
5. Term Eurodollars held by U.S. residents in Canada and the U.K.
6. Overnight retail purchase agreements (Repos)
7. Overnight Eurodollars held by U.S. residents.

Nonfinancial debt is the sum of the following sectors' outstanding debt:

1. U.S. government
2. State and local governments
3. Nonfinancial domestic businesses
4. Households.

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Author Information

Marc Labonte
Specialist in Macroeconomic Policy

Acknowledgments

Gail E. Makinen, a Consultant in Economic Policy, co-authored this report.

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